Energetic Test Sample Preparation and Validation Using Inject Technology

The United States Army and first responders increasingly encounter situations where rapid detection and identification of unknown materials is necessary. These unknowns can be chemical, energetic or biological in nature. To combat the growing threat, several optically-based hazard detection systems are being evaluated for fielded applications. Specifically, in the case of explosives, objects coming into contact with individuals or environments in which materials have been handled or prepared can exhibit trace concentrations of analyte. To accurately identify and detect these residues, fielded detection system performance must be evaluated with well-defined trace level concentrations of analyte. These samples need to be fabricated in a controlled and uniform fashion to ensure accurate testing and system performance evaluation.

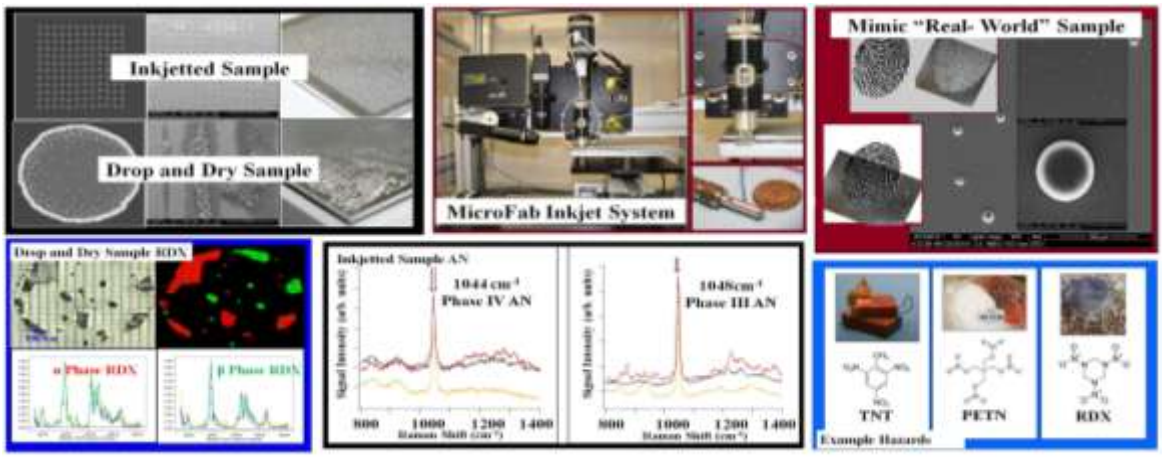

Figure 1. Drop and Dry vs. printed sample demonstrates uniformity difference. Image of printing system demonstrates small particle printing capabilites. Able to print a variety of "real-word" samples like fingerprints. Raman spectra demonstrate various polymorphic phases for RDX and AN. Image of commonly enountered energetic materials.

To answer this Army need, we have developed, optimized and fielded the use of a drop-on-demand table-top inkjet printing platform which offers precise liquid sample deposition and is well suited for the preparation of standardized reference materials. Using this system we are able to accurately and uniformly print trace levels of known hazard materials (e.g. RDX, PETN, TNT, HMX) and homemade explosive (HME) components (e.g. ammonium nitrate (AN), Sugar, urea, and KClO3). We have demonstrated sample uniformity and reproducibility (typical calibration goodness of fit R^2 values of 0.991, relative standard deviation (RSD) ≤ 5%), and thus an established robust methodology for energetic sample preparation. Additionally, we have conclusively shown that a thorough understanding of sample preparation methodologies is necessary, as several of these hazard components can demonstrate polymorphic phase change shifts at trace concentration levels (i.e. RDX, AN).

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